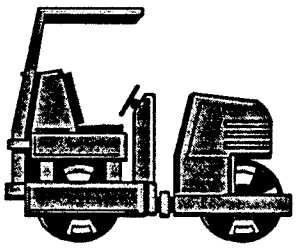
HIGHWAY DESIGN BRANCH



RESURFACING, RESTORATION AND REHABILITATION (R-R-R)
OF HIGHWAYS AND STREETS

DESIGN SERVICES UNIT
ROADWAY DESIGN UNIT

VALUE MANAGEMENT SECTION
SPECIAL SERVICES GROUP

R-R-R GUIDE

APRIL 1995

NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

GUIDE FOR

RESURFACING, RESTORATION AND REHABILITATION (R-R-R)

OF HIGHWAYS AND STREETS (OTHER THAN FREEWAYS)

CONTENTS

NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
GUIDE FOR
RESURFACING, RESTORATION AND REHABILITATION (R-R-R)
OF HIGHWAYS AND STREETS (OTHER THAN FREEWAYS)

PURPOSE

The primary purpose of R-R-R projects is to provide a better riding surface, enhance safety, improve operating conditions, and to preserve and extend the service life of existing non-freeway facilities. Highway safety is an essential element of R-R-R projects. Projects should be developed and designed in a manner which identifies and incorporates safety improvements. Economic considerations are also a major factor in determining the priority and scope of R-R-R projects.

For purposes of this guide, the following definitions apply:

1. Criteria - The term "criteria" as it relates to R-R-R means either specific design criteria or procedures, or a process which establishes geometric design values for individual projects or groups of projects.

2. Maintenance - This work is directed towards maintaining the existing roadway and related appurtenances as necessary for safe and efficient operation. Design improvements are not the normal intent of maintenance operations. Pavement repairs such as seal coats, full width patching, crack sealing, and thin plant mix resurfacings for sealing of the pavement surface correcting minor surface irregularities, etc., are generally considered as maintenance activities. This work is not considered a R-R-R activity.

3. Resurfacing - This work consists of the application of a new or recycled layer or layers of pavement material to existing pavement to provide additional structural integrity or improved rideability.

4. Restoration - This work consists of restoring or generally bringing back the originally designed capability of the facility. This may include, in addition to the resurfacing described above, such activities as minor pavement widening or addition of paved shoulders, culvert extensions, other drainage improvements, correction of superelevation, upgrading safety appurtenances to current standards, and other safety improvements. Generally, restoration activities are confined within the existing right of way.

5. Rehabilitation - In addition to the work described under restoration and resurfacing, this activity may include reconstruction of limited portions of the project's length in order for the facility to better serve existing and short term traffic requirements. Additional right of way may be required.

6. Reconstruction - A project will be considered "reconstruction" if the majority (50 percent or more) of the project length involves vertical and/or horizontal alignment revisions, added lanes or reconstruction of roadway pavement to provide long term service. Reconstruction projects are constructed in accordance with the appropriate new construction criteria and are not considered to be within the scope of this R-R-R guide.

R-R-R DESIGN REFERENCES

1. Designing Safer Roads - (Special Report 214), TRB 1987

2. Technical Advisory - Developing Geometric Design Criteria and Processes For Nonfreeway R-R-R projects (T5040.28), FHWA 1988.

3. Safety Improvements on Horizontal Curves For Two-Lane Rural Roads Informational Guide (FHWA-RD-90-074)

4. Safety Cost-Effectiveness of Incremental Changes in Cross-Section Design -- Informational Guide (FHWA-RD-87-094)

GENERAL REFERENCES

1. A policy on Geometric Design of Highways and Streets, AASHTO 1990.

2. Highway Design and Operational Practices related to Highway Safety, Second Edition, AASHTO 1974.

3. Roadside Design Guide, AASHTO 1988.

4. National Cooperative Highway Research Program (NCHRP) Research Results Digest 98, Safety at Narrow Bridge Sites.

5. Standard Specifications for Highway Bridges, AASHTO 1989 and Addenda.

6. Manual on Uniform Traffic Control Devices (MUTCD), National Advisory Committee on Uniform Traffic Control Devices 1988.

7. N. C. Supplement to the Manual on Uniform Traffic Control Devices, Revised 1990.

8. A Guide For Erecting Mailboxes on Highways, AASHTO, 1984.

9. State Highway General Ordinance 19A:NCAC:02E.0404 Highway Obstructions.

10. Truck Characteristics For Use in Highway Design and Operation. (FHWA-RD-89-226)

11. N.C. Map of National Truck Network.

BACKGROUND

It is apparent for the foreseeable future that available funds will be insufficient to improve existing highways and streets to the geometric and pavement standards desirable for reconstruction and new construction. This situation was recognized in the Federal-Aid Highway Act of 1976 which broadened the term "construction" to include "resurfacing, restoration and rehabilitation". The intent of this legislation was to permit the use of Federal-Aid highway funds to rehabilitate highways to extend their useful life without necessarily improving existing geometrics.

Part 625 of Title 23, Code of Federal Regulations, "Highways" (23 CFR 625), was revised on June 4, 1982 (47 FR 25263, June 10, 1982), to allow greater flexibility and local discretion in the geometric design of non-freeway R-R-R projects. Effective July 2, 1982, minimum geometric design criteria adopted for new construction and reconstruction no longer apply to Federal-Aid non-freeway R-R-R projects unless a state specifically proposes adoption of those criteria for non-freeway R-R-R projects. Separate Geometric Design Criteria may be developed and adopted by each state for non-freeway R-R-R projects.

Part 625 was further revised on March 24, 1983 (48 FR 13410, March 31, 1983), to comply with new subsection 109(o), Title 23, United States Code, added by Section 110(a) of the Surface Transportation Assistance Act of 1982. The new subsection clarifies that federally funded non-freeway R-R-R projects shall be constructed to preserve and extend the service life of existing highways and enhance highway safety.

Technical Advisory T 5040.21, Geometric Design Criteria for Non-Freeway R-R-R Projects, dated April 4, 1983, was issued to provide guidance relating to 11 factors to be addressed, as a minimum, in the geometric design criteria developed by a state for use on R-R-R projects.

Part 625 was again revised on April 9, 1985 (50 FR 14914, April 15, 1985), to adopt as policy for Geometric Design, a new publication by The American Association of State Highway and Transportation Officials entitled "A Policy on Geometric Design of Highways and Streets". In the FHWA's memorandum dated April 15, 1985, subject "Implementation of New Design Criteria for Federal-Aid Projects", 13 controlling criteria were identified. Design elements which deviate below these minimum criteria require a formal design exception.

"Special Report 214, Designing Safer Roads, Practices for Resurfacing, Restoration, and Rehabilitation", Transportation Research Board (TRB), 1987, was the result of a study on Safety Cost-Effectiveness of Highway Geometric Design Standards for R-R-R projects on existing Federal-Aid highways as mandated by the Surface Transportation Assistance Act of 1982. Part 625 was amended on April 25, 1988 (53 FR 15669, May 3, 1988) to add this report as a guide and reference to the list of publications for application on Federal-Aid projects.

Technical Advisory T5040.28, Developing Geometric Design Criteria and Processes for Non-Freeway R-R-R Projects, dated October 17, 1988, was issued to replace T5040.21 and provides recommendations on design criteria and procedures based on the findings of Special Report 214. To obtain the greatest traffic service and safety benefits, T5040.21 addresses each of the 13 geometric elements established as the controlling criteria for geometric design. The controlling criteria are design speed, lane and shoulder widths, bridge widths, structural capacity, horizontal and vertical alignment, stopping sight distance, grades, cross slopes, superelevation, and horizontal (clear recovery area) and vertical clearances. Design exceptions are required when deviating below the minimum values for any of these except horizontal clearance.

This guide establishes broad limits by presenting minimum values for design and allowing engineering judgement to be applied. Engineering judgement shall be used to achieve desirable levels of traffic service and safety appropriate to the social, economic, and environmental controls applicable to specific projects.

EXAMPLES AND OBJECTIVES

The following list of improvements may be applicable to R-R-R projects; however, it is not intended to be all inclusive. Each project should be examined to determine the scope of improvements which are appropriate and socially, economically, and environmentally acceptable.

- Improve surface smoothness to obtain better rideability, reduce fuel consumption, and enhance safety.
- Extend pavement life.
- Widen narrow pavement.
- Widen narrow shoulders.
- Construct paved shoulders.
- Reduce pavement edge drop offs.
- Reconstruct short sections of roadway having poor foundations.
- Improve horizontal and vertical alignments.
- Improve superelevation.
- Improve the clear recovery area.
- Provide adequate signing and delineation for narrow bridges.
- Remove or otherwise mitigate roadside obstructions such as driveway pipe and headwalls which are located within the designated recovery area.

- Provide funnel drains at bridge ends.
- Replace expansion joint seals on bridge.
- Restore or replace bridge approach slab.
- Extend or replace box culverts.
- Increase vertical and horizontal clearances to obstructions.
- Flatten slopes where justified by accident experience.
- Improve safety at recorded and potentially hazardous locations.
- Restore or replace deteriorated bridge decks.
- Rehabilitate obsolete bridge rails and guardrails to bridge rail transition.
- Replace bridge structures (under special conditions).
- Upgrade traffic barriers and install new ones where needed.
- Replace or remove to outside clear area, mailbox posts not in compliance with current AASHTO and State standards.
- Provide or upgrade impact attenuators and breakaway devices.
- Provide drainage modifications.
- Install or upgrade signing, signals, and pavement markings.
- Improve traffic operations by adding lanes at intersections, climbing lanes, or continuous lanes for left turns or through movements.
- Improve sight distance at intersections.
- Provide channelization.
- Improve skid resistance.
- Provide for control of erosion.

PROCEDURE

The Transportation Improvement Program will identify R-R-R type projects. The initial scope and schedule should include safety and/or pavement improvements and any right of way requirements. A planning document will be prepared by the Planning and Environmental Branch detailing the proposed improvements. The planning document will include appropriate consideration of the safety, social, economic, and environmental consequences of the project. The planning document will identify any permits which may be required.

Field reviews must be held during the planning and design process. Appropriate design, traffic, and division staff should be included on all field reviews. Planning documents and plans should have the concurrence of the State Traffic Engineer or his/her representative. Federal-Aid projects must be coordinated with the appropriate FHWA Staff.

EXCEPTIONS TO GUIDELINES

Any design exceptions to this R-R-R Guide should be identified in the planning document. On federal aid projects requiring step by step FHWA review, the critical design elements not meeting R-R-R criteria, will require an approved design exception from the Federal Highway Administration. AASHTO Standards will apply to those critical design elements not addressed in this R-R-R Guide. The critical design elements are: design speed, lane width, shoulder width, bridge width, structural capacity, vertical clearance, horizontal alignment, vertical alignment, stopping sight distance, cross slope, superelevation, design life, and grades. The information needed in the design exception request is shown on Figure 4, Page 19.

DESIGN GUIDES

TOPOGRAPHY AND PHYSICAL FEATURES

Rugged terrain, such as encountered in our mountainous regions, and areas with heavy roadside development will often limit typical section improvements. These conditions should be reflected in the selection of cross-section element values near or at the minimum widths shown in Table 2 on Page 15.

TRAFFIC DATA

Although the basic purpose of the R-R-R project is to recondition the facility so existing traffic demands can be satisfied, traffic volumes shall be projected ten (10) years to assure that:

1. The pavement design will meet structural requirements for future traffic.

2. R-R-R treatment is appropriate for the facility in question. A significant projected increase in traffic volume may indicate the need for reconstruction rather than R-R-R treatment.

Traffic data required for R-R-R projects are as follows:

1. Current and projected (10 year) ADT

2. Percent trucks (TTST & Duals) as a minimum is required.

3. Current and projected intersection turning movements

4. Accident analysis (number, location, and description)

5. Appropriate speed studies as necessary.

DESIGN VEHICLE

The standard design vehicle should be the WB 50.

For routes located on the National Truck Network, lane widths should be 12'. Where feasible this should also include the portion of routes that provide "reasonable access" to and from the National Truck Network routes. The design vehicles to be used on these routes are the twin-trailer (WB-60) and the 48/53 foot semi-trailer (WB-62) since both of these vehicles are restricted to these routes. (See Page 23 for the N.C. National Truck Network Routes.)

SAFETY ENHANCEMENT CONSIDERATIONS

Safety considerations are an integral part of every R-R-R project.

A skid resistant pavement is an essential part of all pavement surface improvements. Only those surface course mixes containing aggregates approved by Materials and Test Unit shall be utilized on R-R-R projects.

Accident data provided by the Traffic Engineering Branch will be required for each R-R-R project. The Traffic Engineering Branch will analyze this data and provide recommendations for improvements at each location where there has been significant accident experience and at locations where reasonable engineering judgement indicates a high potential for accidents. Consideration will be given to including measures which will provide for safer traffic operations. These measures can range from corrections of hazardous alignment to the placement of warning signs and markers. Accident locations associated with limited sight distance on horizontal curves can possibly be corrected by selective clearing or minor slope flattening.

A clear traversable recovery area is desirable for roadside areas. Additional right of way may be needed to provide the necessary clear recovery areas. This is particularly critical in high frequency accident locations. Obstructions located within the clear zone should be removed, shielded, or made crashworthy. On some projects clear recovery areas may not be economical because of existing topographic features and right of way limitations.

Where traffic barriers or attenuators are required to shield roadside obstacles, their installation shall be in accordance with the Roadside Design Guide (AASHTO) and the Roadway Design Unit's standard drawings.

HIGHWAY SYSTEM CLASSIFICATION

For purposes of establishing roadway cross-section element values, R-R-R projects are categorized by the following three highway system classifications:

1. Arterial System - These highways, including expressways, accommodate moderate to high volumes of traffic for travel between major points. These highways are primarily for through traffic, usually on a continuous route, and are generally the top 10% of the total highway system based on relative importance for statewide travel.

2. Collector System - Provides primarily intracounty service with shorter travel distances and generally more moderate speeds. These routes provide service to county seats and towns not on the arterial system. Routes which carry traffic from local roads to arterials are collectors.

3. Local System - Provides access to farms, residences, businesses, or other abutting properties. The traffic volumes generated by the abutting land uses are largely short trips or a relatively small part of longer trips where the local road connects with major streets or highways of higher classifications.

The Non-Freeway North Carolina Highway System has been classified by these functional classifications. The project planning report will include the proper classification for the road being improved.

DESIGN ELEMENTS

DESIGN SPEED

The design speed should be selected that best coordinates the various geometric elements to produce a safe highway. There are two methods available in selecting the project design speed. One method is to select an overall design speed that meets or exceeds the posted or statutory speed limit. Another method is to use the 85th percentile speed as determined by the Traffic Engineering Branch. This method is especially suited for mountainous conditions where the running speed is lower than the statutory speed and the roadway must be posted accordingly. Whichever method is used, the selected design speed shall in all cases meet or exceed the posted or statutory speed limit.

CLEAR RECOVERY AREA

Each R-R-R project should seek to improve and establish a consistent clear roadside recovery area. Typical improvements could be tree removal, utility pole relocation, extension of cross pipes, removal of driveway endwalls and non-standard mailbox posts, regrading hazardous ditches, and flattening fill slopes.

It is desirable to obtain a clear recovery distance as shown in Table 5 on page 21. However, in some areas there will be right of way, terrain, or other cost restrictions that preclude establishing a desirable clear zone. In these cases, factors such as existing right of way width, accident history, projected traffic, roadway alignment, and cost should be considered in establishing a consistent clear recovery area. Of particular importance is the area on the outside of horizontal curves where the probabilities of accidents are greater. The distances listed below are a recommended minimum for clear recovery areas. Engineering judgement should be used and desirable widths of clear recovery areas, shown in the AASHTO Roadside Design Guide, should be obtained whenever possible.

DESIGN SPEED	MINIMUM CLEAR RECOVERY AREA
55 mph	15′
45 mph	10′
35 mph	5′

Right of way costs should be considered in determining cost effectiveness of providing clear areas. However, the purchase of right of way or easements should not necessarily prohibit the establishment of a clear recovery area.

HIGHWAY OBSTRUCTIONS

Refer to the current N.C. D.O.T. Highway Obstructions Policy.

Note: HIGHWAY OBSTRUCTIONS INCLUDE DRIVEWAY HEADWALLS, FENCES, RURAL MAILBOXES, NEWSPAPER DELIVERY BOXES, UTILITY POLES AND OTHER ROADSIDE OBSTRUCTIONS WHICH INTERFERE WITH TRAFFIC OR MAINTENANCE

Engineering judgement should be used to assess the benefit of mitigating highway obstructions located within a desired clear recovery area. It would be impractical to remove specific obstructions from a designated clear recovery area containing large or numerous other obstructions deemed too costly to mitigate.

HORIZONTAL AND VERTICAL ALIGNMENT

R-R-R projects should include examinations of potential hazards at intersections, sharp horizontal curves, short crest vertical curves or narrow bridges hidden by a vertical curve, particularly the highway stopping sight distance fall below new construction standards. The investigation into the cost effectiveness of mitigation measures should assess the value of potential accident reductions.

If curve reconstruction is not justified, or if the curve is reconstructed to less than new construction standards, then appropriate safety and other mitigation measures should be applied. These safety measures include, but are not limited to:

the addition of traffic control devices (chevron signs, curve signs, advisory speed signs, or delineators), shoulder widening, appropriate superelevation, slope flattening, pavement anti-skid treatment, driveway relocation, or obstacle removal or shielding. These measures may be applied either separately or in combination.

The first substandard curve in a series should receive special attention because this change in alignment prepares the driver for the remaining curves in a series.

Two Lane Roadways - Horizontal Curves

An existing horizontal curve may be retained as is without further evaluation if:

The existing curve design, assuming correct super-elevation is provided, corresponds to a speed that is within 10 miles of the posted speed and the accident rate is below statewide averages provided by Traffic Engineering Branch. Reconstruction to either new construction standards or to these R-R-R standards is to be considered and evaluated when the previously discussed speed and accident criteria are exceeded. A cost effectiveness evaluation should be performed following the procedure contained in the May 1990 informational guide entitled "Safety Improvements on Horizontal Curves for Two-Lane Rural Roads". This analysis considers the safety benefit and cost of: widening the roadway or paved shoulder width, improving superelevation, reconstruction, and improving roadside clear recovery areas.

TWO-LANE ROADWAYS - VERTICAL CURVES

1. An existing vertical curve may be retained if the curve design speed is within 20 mph of the posted or statutory speed limit and the design volumes are less than 1,500 ADT.

2. An existing vertical curve may be retained if the curve design speed is within 10 mph of the posted or statutory speed limit and the accident rate is below the statewide average.

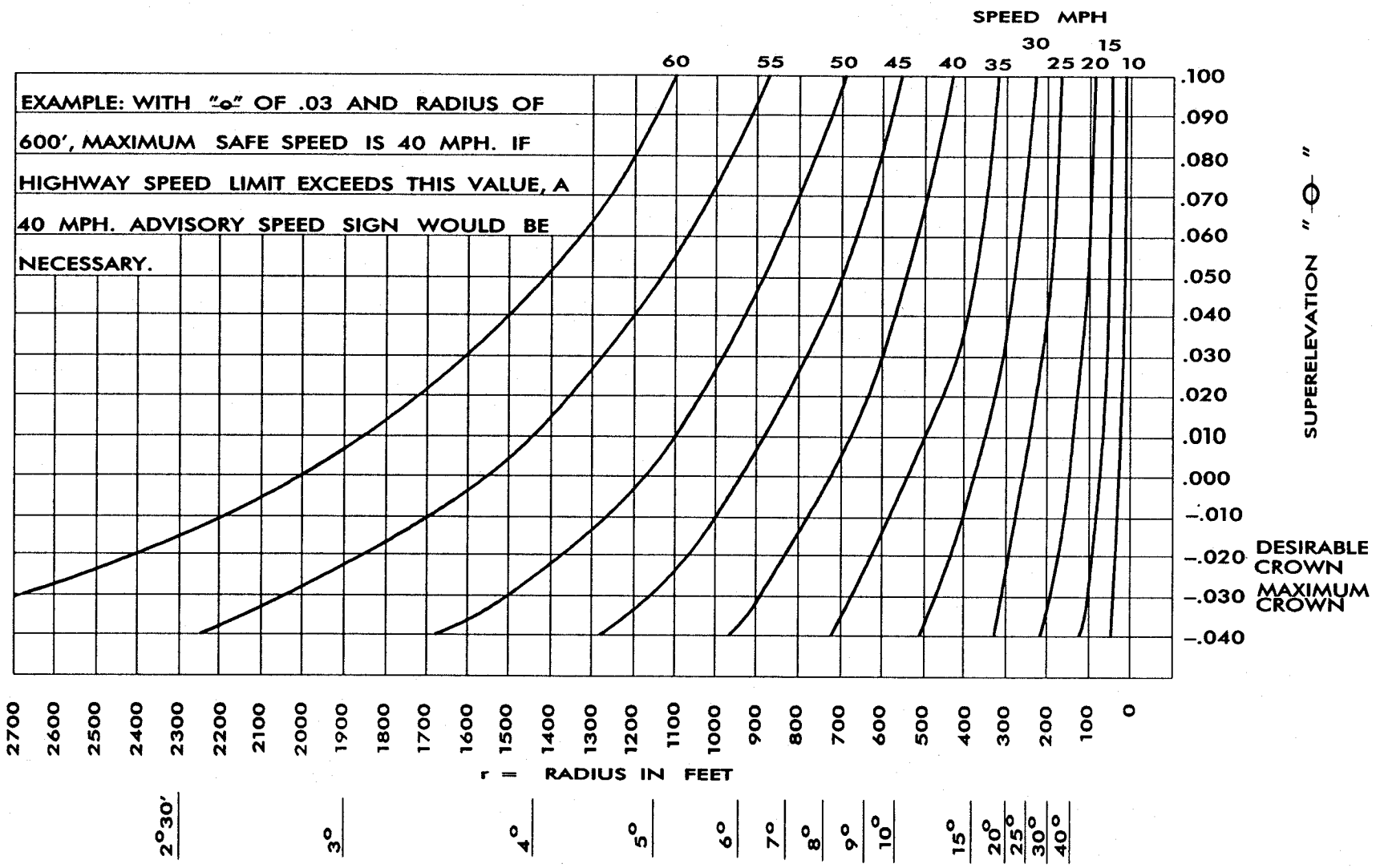
A design exception is required for horizontal and vertical curves that do not meet the above R-R-R criteria.

FOUR-LANE ROADWAYS - VERTICAL CURVES AND HORIZONTAL CURVES

1. An existing vertical or horizontal curve may be retained if the curve design speed meets the posted or statutory speed limit. A design exception is required if the horizontal or vertical curve design speed is less than the posted or statutory speed.

GRADES

The existing roadway grade may be retained if the accident rate is below the statewide average. Climbing lanes and truck escape ramps should be considered on long steep grades.



DESIGN SERVICES
GRAPHICS

FIGURE 1. MINIMUM AASHTO SUPERELEVATION RATES

SUPERELEVATION

It is desirable to superelevate curves in accordance with the AASHTO Guidelines for new construction. On R-R-R projects, constraints of excessive costs often preclude the use of desirable AASHTO superelevation rates. Figure 1, Page 12, indicates minimum-AASHTO superelevation rates for a given degree of curve and speed. If these minimum superelevation rates cannot be met, the maximum speed for a curve can be determined from Figure 1 on Page 12 or by using a ball bank indicator. The curve is to be signed and marked for the appropriate speed in accordance with the provisions of the "Manual On Uniform Traffic Control Devices For Streets And Highways" (MUTCD) if minimum superelevation rates cannot be achieved.

In some cases, reconstruction of substandard horizontal curves to larger radii may be feasible in lieu of increasing the superelevation. (See Figure 1 on Page 12.)

INTERSECTIONS

Intersection geometry and design deserve some attention since accidents tend to concentrate at these locations. A primary purpose of R-R-R improvements is to correct an existing or potential safety problem. Capacity improvements are desirable but secondary to the main purpose of R-R-R projects. The cost of any improvements must be weighed versus potential accident reductions. Intersection improvements could consist of adding turn lanes, improving sight distance, adding traffic signals, improving pavement markings, or adding warning signs.

DRAINAGE

Surface drainage and pavement drainage improvements and pipe end treatments on R-R-R projects will be in accordance with Hydrographic Unit and Pavement Management Unit recommendations and the Roadway Design Manual.

UTILITIES

The disposition of utilities on R-R-R projects will be as recommended by the Utility Section of the Right of Way Branch. All utility poles should be removed from the clear recovery area or treated with shield and/or breakaway devices.

SIGNS, SIGNALS AND MARKINGS

Signs, signals and markings on R-R-R projects will conform to the requirements of the current "Manual On Uniform Traffic Control Devices For Streets And Highways" and the N.C. Supplement to the MUTCD.

PAVEMENT CROSS-SLOPE

Although pavement cross slopes of 2% (Normal Crown = 1/4" per foot) are preferred, actual slopes of 1% (1/8" per foot) to 3%

(3/8" per foot) are acceptable. Existing pavement cross slopes on R-R-R projects should be revised to fall within this range.

LANE WIDTHS AND SHOULDER WIDTHS

The lane and shoulder widths shown on Table 2 (Page 15) are the minimum acceptable values for R-R-R projects.

Pavement widening for horizontal curves, where justified, shall be done in accordance with latest AASHTO guidelines.

PAVED SHOULDERS

Refer to the current N.C. D.O.T. Paved Shoulder Policy.

CURBS

Curbs and/or shoulder gutter may be utilized in rugged terrain and highly developed areas to control drainage and/or to minimize right of way requirements.

It is desirable in high speed facilities (50 mph or greater) that curb not exceed 4" in height when used in conjunction with guardrail.

DITCHES

It is desirable to obtain a traversable ditch section on R-R-R projects. This requires ditch front slopes and back slopes as shown on Figure 6, page 22. There will be entire projects, or parts of projects, where this treatment is not cost effective. Priority should be given to hazardous ditches on the outside of curves and in high accident areas. When a non-traversable roadway ditch is to remain in place, the front slope should not be steeper than 4:1 (3:1 in mountainous terrain) with a minimum ditch depth capable of meeting drainage requirements.

ROADSIDE VEGETATION

It is desirable that the existing slopes and ditches within the identified project limits which are not to be regraded, be stablized by vegetation or other erosion control device such that the project not be in a significantly erodible state. This is particularly important where the project is within a natural drainage area of high quality waters such as trout streams or coastal sounds.

TABLE 2

Minimum Lane and Shoulder Widths for R-R-R Projects

Design Speed	Current ADT	Arterial		Collector		Local	
		Pavement	Shoulder	Pavement	Shoulder	Pavement	Shoulder
50 mph and over	0 - 1000	11	4	10	3	10	3
	1000 - 2000	12	6	11	4	11	3
	Over 2000	12	6	11	6	11	6
Under 50 mph	0 - 1000	11	4	10	3	10	3
	1000 - 2000	11	4	10	3	10	3
	Over 2000	12	6	11	6	11	6
50 mph and over (rugged terrain)	0 - 1000	10	3	10	3	10	3
	1000 - 2000	11	3	11	3	11	3
	Over 2000	12	4	11	4	11	4
Under 50 mph (rugged terrain)	0 - 1000	10	3	10	3	10	3
	1000 - 2000	11	3	10	3	10	3
	Over 2000	12	4	11	4	11	4

NOTES:

1. Shoulder dimensions indicate graded widths and include paved shoulder widths.
2. Where guardrail is to be installed, graded shoulder width must be increased by 3'.
3. Where truck (TTST and Duals) volume exceeds 10% of current ADT, lane widths should be increased by 1' to a maximum of 12'. 12' lane width should be used on routes designated as part of the National Truck Network.
4. Refer to current Paved Shoulder Policy for additional information concerning paved shoulder widths.

GUARDRAIL

Use Chapter 3-1 of the Roadway Design Manual to determine guardrail needs and location. Use the warrant charts F-4 through F-12 to determine the guardrail requirements for roadway fill locations.

BRIDGES

The project planning report will contain recommendations concerning the disposition of any bridge within the limits of or contiguous to a R-R-R project. If replacement is required, the new bridge should be constructed in accordance with the current North Carolina Department of Transportation's Bridge Policy.

Bridges requiring replacement or major rehabilitation will normally be done using Bridge Replacement funds. The project planning report will address this matter and make a recommendation on the source of funding.

On R-R-R projects, bridges requiring no work or only minor structural rehabilitation may remain in place if the following requirements are met:

1. The bridge clear width is equal to or greater than the minimum widths shown in Table 3 (Page 18) and accident experience indicates no accident problems exist.

2. Vertical clearance equal to or greater than the minimum clearance shown in Table 3 and there is no history of damages due to overheight vehicles.

3. Bridge railings and transitions are revised to provide for adequate strength and geometric standards in accordance with current AASHTO "Standard Specifications for Highway Bridges".

4. The bridge has been rated and posted, if necessary, in accordance with the "Manual for Maintenance Inspection, Rating and Posting of Bridges on the North Carolina Highway System" to a weight limit determined to meet the needs of the route served; however, the safe load capacity shall be sufficient to carry school buses and vital service vehicles when there is no reasonable or adequate alternate route.

If these requirements cannot be met, then a design exception will be necessary.

Bridges within or contiguous to R-R-R projects shall be signed and marked in accordance with the MUTCD and N.C. supplement to MUTCD and the criteria as specified in the AASHTO report, "Highway Design and Operational Practices Related to Highway Safety, Second Edition, 1974". Approach traffic barriers are to be in conformance with AASHTO Roadside Design Guide, 1988.

If a bridge is to remain in place, an evaluation must be made to determine what treatment, if any, is required for operational and structural adequacy. National Cooperative Highway Research Program (NCHRP) Research Results Digest 98, "Safety at Narrow Bridge Sites", provides guidance for making operational safety evaluations. Where accident data indicates a problem on a bridge, an analysis will be made to determine the necessary corrective action such as providing improved transitions, rehabilitation or replacement.

Action taken, if any, in revising vertical clearance at existing overpass structures will be based on the traffic characteristics of the route, history of damages due to overheight vehicles, cost required to increase the vertical clearance, and the availability of an adequate alternative route.

On bridges requiring major structural rehabilitation or replacement, the following requirements must be met:

1. HS-20 design live load in accordance with the current AASHTO "Standard Specifications for Highway Bridges". Emphasis is placed on the fact that a lower design live load may be determined to be acceptable if it meets the needs of the route served.

2. Strength and geometric requirements for bridge railings based on the current AASHTO "Standard Specifications for Highway Bridges".

3. Bridge clear roadway width requirements of the current North Carolina Department of Transportation's policy for new and reconstructed bridges. When it is not practical to widen bridges to these geometric standards (due to such factors as physical constraints and/or operational characteristics), an analysis will be required for review and approval as a design exception.

TABLE 3

MINIMUM CLEAR ROADWAY WIDTH FOR BRIDGES TO REMAIN IN PLACE (IN FEET)				
CURRENT ADT	DESIGN ADT	LOCAL (a)	COLLECTOR (a)	ARTERIAL
0 - 250		20 (b)	22	28 (d)
over 250	under 2,000	22	22	28 (d)
	2,000 - 4,000	24	24	28 (c)
	4,000 - 30,000	28	28	28 (c)
	over 30,000	28	28	28 (c)
MINIMUM VERTICAL CLEARANCES FOR BRIDGES TO REMAIN IN PLACE				
		14	14	14

(a) Bridges longer than 100 feet may be analyzed individually in accordance with AASHTO.

(b) For bridges with current ADT < 50, an 18-foot width may be retained, provided that the approach travel way width is 18 feet or less.

(c) Ultimate widening should be considered for all existing bridges with less than 3-foot offsets to parapets.

(d) For arterials with 11-foot lanes and design speeds of 40 mph or less, 26 feet may be used.

FIGURE 4

DATE _____

PROJECT ENGINEER: _____

DESIGN EXCEPTION REQUEST FOR A Federal-Aid PROJECT

Fed Aid Project No.: State Project No.:

TIP No.: County:

Design Exception Requested for: (design speed, design life, bridge width, lane or shoulder width, structural capacity, vertical clearance, stopping sight distance, horizontal or vertical alignment, grades, cross slopes, superelevation)

Location of Design Feature in Question:

PROJECT DATA

Current ADT (Year): Design ADT (Year):

% Trucks: * Dual Tire _____%
3+ Axle Single Unit _____%
TTST _____%
Twin Trailer _____%

Design Speed:

Posted or Statutory Speed:

Functional Classification:

Minimum AASHTO R-R-R Dimensions: Dimensions Proposed:

Total Estimated Cost of Project:

Additional Cost to Meet Minimum AASHTO R-R-R Requirements:

BASIS FOR EXCEPTION

1. Describe how the accident history relates to the proposed design exception. See current 3-year accident history, attached (number, type, rates, severity, cause, comparison to statewide average, etc.).

*The percent trucks will be supplied by the Traffic Engineering Unit

2. Describe any future plans for upgrading this roadway either at or in the vicinity of this project.

3. Describe the cross section, geometrics, access control, etc. of the existing roadway outside the project limits.

4. Explain why it is not reasonable or feasible to meet (engineering, environmental and/or ROW constraints) minimum AASHTO R-R-R requirements.

5. Describe any measures proposed to mitigate the design element that is below standards.

FIGURE 5. CLEAR ZONE DISTANCES (IN FEET FROM EDGE OF DRIVING LANE)

DESIGN SPEED	DESIGN ADT	FILL SOPES			CUT SLOPES		
		6:1 OR FLATTER	5:1 TO 4:1	3:1	3:1	4:1 TO 5:1	6:1 OR FLATTER
40 MPH OR LESS	UNDER 750	7–10	7–10	**	7–10	7–10	7–10
	750–1500	10–12	12–14	**	10–12	10–12	10–12
	1500–6000	12–14	14–16	**	12–14	12–14	12–14
	OVER 6000	14–16	16–18	**	14–16	14–16	14–16
45–50 MPH	UNDER 750	10–12	12–14	**	8–10	8–10	10–12
	750–1500	12–14	16–20	**	10–12	12–14	14–16
	1500–6000	16–18	20–26	**	12–14	14–16	16–18
	OVER 6000	18–20	24–28	**	14–16	18–20	20–22
55 MPH	UNDER 750	12–14	14–18	**	8–10	10–12	10–12
	750–1500	16–18	20–24	**	10–12	14–16	16–18
	1500–6000	20–22	24–30	**	14–16	16–18	20–22
	OVER 6000	22–24	26–32*	**	16–18	20–22	22–24
60 MPH	UNDER 750	16–18	20–24	**	10–12	12–14	14–16
	750–1500	20–24	26–32*	**	12–14	16–18	20–22
	1500–6000	26–30	32–40*	**	14–18	18–22	24–26
	OVER 6000	30–32*	36–44*	**	20–22	24–26	26–28
65–70 MPH	UNDER 750	18–20	20–26	**	10–12	14–16	14–16
	750–1500	24–26	28–36*	**	12–16	18–20	20–22
	1500–6000	28–32*	34–42*	**	16–20	22–24	26–28
	OVER 6000	30–34*	38–46*	**	22–24	26–30	28–30

* WHERE A SITE SPECIFIC INVESTIGATION INDICATES A HIGH PROBABILITY OF CONTINUING ACCIDENTS, OR SUCH OCCURRENCES ARE INDICATED BY ACCIDENT HISTORY, THE DESIGNER MAY PROVIDE CLEAR ZONE DISTANCES GREATER THAN 30 FEET AS INDICATED. CLEAR ZONES MAY BE LIMITED TO 30 FEET FOR PRACTICALITY AND TO PROVIDE A CONSISTENT ROADWAY TEMPLATE IF PREVIOUS EXPERIENCE WITH SIMILAR PROJECTS OR DESIGNS INDICATES SATISFACTORY PERFORMANCE.

** SINCE RECOVERY IS LESS LIKELY ON THE UNSHIELDED, TRAVERSABLE 3:1 SLOPES, FIXED OBJECTS SHOULD NOT BE PRESENT IN THE VICINITY OF THE TOE OF THESE SLOPES. RECOVERY OF HIGH SPEED VEHICLES THAT ENCROACH BEYOND THE EDGE OF SHOULDER MAY BE EXPECTED TO OCCUR BEYOND THE TOE OF SLOPE. DETERMINATION OF THE WIDTH OF THE RECOVERY AREA AT THE TOE OF SLOPE SHOULD TAKE INTO CONSIDERATION RIGHT OF WAY AVAILABILITY, ENVIRONMENTAL CONCERNS, ECONOMIC FACTORS, SAFETY NEEDS, AND ACCIDENT HISTORIES. ALSO, THE DISTANCE BETWEEN THE EDGE OF THE TRAVEL LANE AND THE BEGINNING OF THE 3:1 SLOPE SHOULD INFLUENCE THE RECOVERY AREA PROVIDED AT THE TOE OF SLOPE. WHILE THE APPLICATION MAY BE LIMITED BY SEVERAL FACTORS, THE FILL SLOPE PARAMETERS WHICH MAY ENTER INTO DETERMINING A MAXIMUM DESIRABLE RECOVERY AREA ARE ILLUSTRATED IN FIGURE 3.2 (ROADSIDE DESIGN GUIDE.)

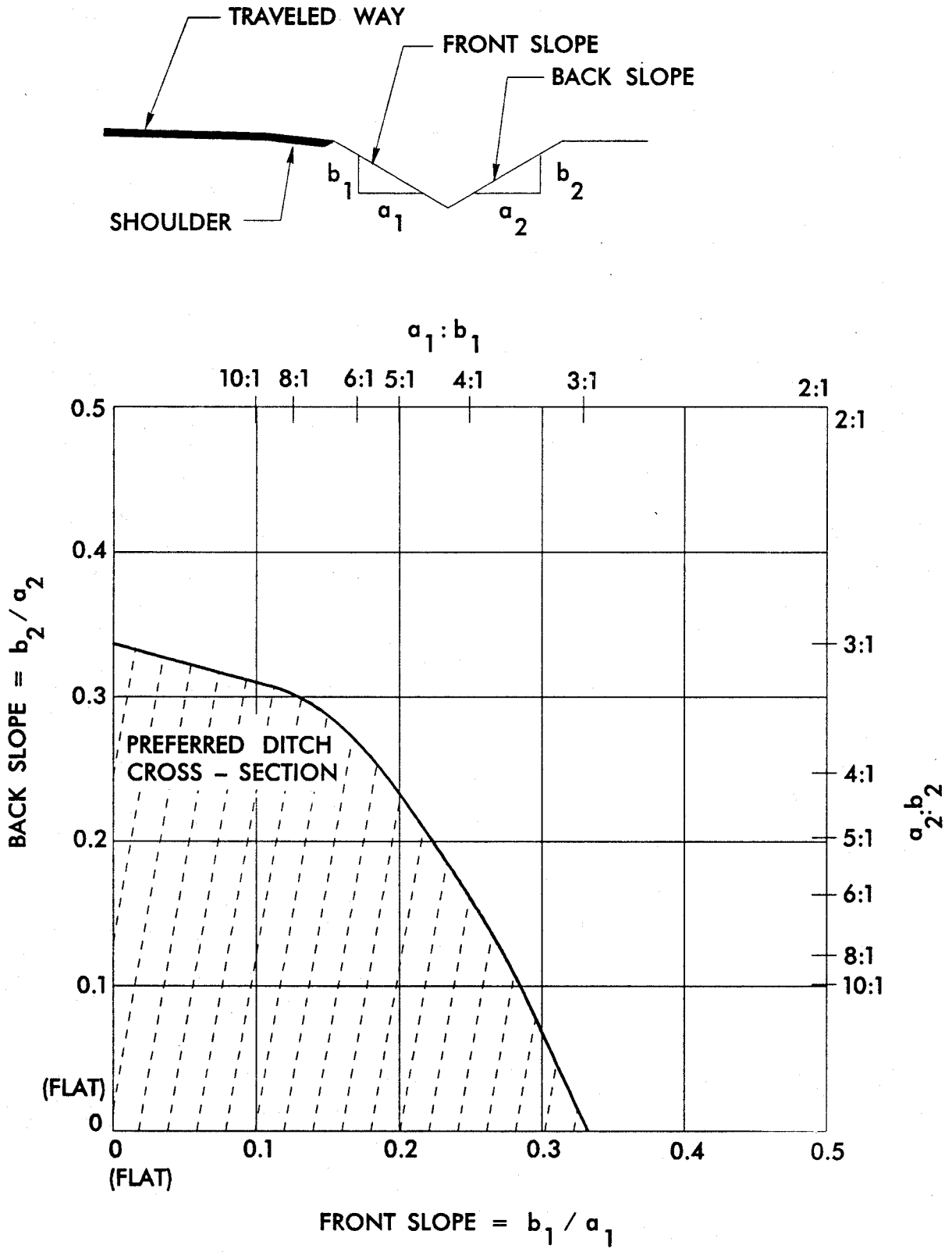


FIGURE 6

PREFERRED CROSS SECTIONS FOR DITCHES WITH GRADUAL SLOPE CHANGES. THIS CHART IS APPLICABLE TO ROUNDED DITCHES WTH BOTTOM WIDTHS OF 8 FEET OR MORE, AND TO TRAPEZOIDAL DITCHES WITH BOTTOM WIDTHS EQUAL TO OR GREATER THAN 4 FEET.